

Modelling information literacy for classrooms of the future

Introduction

Recent years have seen the emergence of numerous 'second generation' concepts such as Web 2.0 and Pedagogy 2.0, which indicate a marked departure from educational and information practices of the past. In broad terms, Web 2.0 services and tools are designed to be participatory, as users no longer simply access knowledge, but play an active role in creating it. This has led to an expansion in what can be considered to be a source of information, as wikis, blogs and social media have become increasingly important, especially for highly current information. Likewise, Pedagogy 2.0 is also based on an, "architecture of participation" (O'Reilly, 2004) as learners become not only consumers, but also producers, of knowledge. Although the term itself may not be familiar to all, teachers are increasingly adopting Pedagogy 2.0 approaches, following "a model of learning in which students are empowered to participate, communicate, and create knowledge, exercising a high level of agency and control over the learning process" (McLoughlin and Lee, 2009, p.355) and encouraging their students to participate in learning communities and networks. The availability of new Web 2.0 technologies mean that teachers have access to resources which can "enhance reflective and dialogical learning, increase student autonomy and help create learning communities in the classroom" (Farkas, 2012 p.82). Such social constructivist approaches are resulting in changing roles for both teachers and students as traditional didactic instruction is replaced by discursive, experiential learning.

Alongside Web 2.0 and Pedagogy 2.0, Information Literacy (IL) 2.0 has also emerged. For some, IL 2.0 is viewed simply as "the application of interactive, collaborative, and multimedia technologies to web-based library services and collections" (Maness, 2006). However, it has been argued that, to capture the spirit of second generation concepts, the term should encompass a complete re-examination of information literacy definitions and conceptions and the adoption of a "brand new philosophy of information literacy in general" (Spiranac and Zorica, 2010, p. 144). As Spiranac and Zorica have pointed out, recent changes in learning and information environments and approaches have altered the role of information users as, "highly user-centred and participatory approaches" have meant that, "users have changed their role by becoming information producers, creators and co-creators." (Spiranac and Zorica, 2010, p.142). A practical example of this is in the development of 'makerspaces' in libraries which, "focus on *making* rather than merely *consuming*" (Colegrove, 2013). IL 2.0 therefore needs to take account of the way in which the development of participatory Web 2.0 applications and services has given users greater influence over systems of information provision and production as they can more easily add and organise their own content, thus contributing to the development of information sources and knowledge. In summary, while it is widely accepted that information literacy needs to adapt and develop in response to changes in both technology and pedagogy, the nature of this development is, as yet, uncertain.

Numerous information literacy models have been developed to support both learners and teachers at various levels of education in developing information literacy skills, but most were designed, primarily, for use with more traditional technologies and pedagogies. Identifying common components of some of the most well-used information literacy models, this article considers how effectively they might support some more innovative forms of pedagogy and technology applications. The focus is on the innovative approaches which have been introduced to primary and secondary schools through iTEC (Innovative Technologies for Engaging Classrooms), a major EU-funded project in which European Schoolnet is working with education ministries, technology providers and research organisations to bring about transformation in learning and teaching through the strategic application of learning technology (European Schoolnet, nd).

Background to iTEC

The iTEC project is working to define an achievable vision of technology-supported learning, compatible with European schools, which will enhance the ability of education systems to focus on the effective use of technology. The iTEC approach is designed to bring about change in classroom practice, in order to better prepare young people for the challenges of society and the workplace. This approach encourages the use of inspiring and innovative Learning Activities, which are based upon innovative visions of the future classroom and involve advanced pedagogical approaches, supported by effective use of ICT. Important features of iTEC include support for constructivist pedagogies; developing twenty-first century skills (Binkley et al, 2012); introducing innovative and student-centred technologies into the classroom; and the encouragement of collaboration and group work, alongside developing the role of the teacher as guide or mentor.

School pilots, involving both primary and secondary schools, are being delivered over four years (2010-14) in five overlapping 18-month cycles. The number of countries involved varies between cycles as does the number of teachers (each of whom runs pilots with 1 to 3 cohorts of learners). During the three cycles which have been completed to date, 278 cohorts from 17 countries participated in Cycle 1; 421 cohorts from 15 countries in Cycle 2; and 407 cohorts from 18 countries in Cycle 3. A team from ~~[name of research centre]~~the Education and Social Research Institute (ESRI) at Manchester Metropolitan University~~[name of university]~~ (MMU) in the UK is responsible for the evaluation of iTEC. At the end of each cycle, teachers who have participated complete an online questionnaire about their experiences, focusing on the perceived benefits, enabling factors, challenges encountered and potential for innovation. Each country has a national co-ordinator who oversees the project and support teachers. Each national co-ordinator conducts approximately three case studies involving lesson observation and interviews with teachers, headteachers, ICT co-ordinators and students. These are returned to the evaluation team as two case study reports and one set of transcripts. At the end of each cycle, each national co-ordinator also summarises experiences at a country level, either via interview or questionnaire. These qualitative data are analysed using Nvivo. Transcriptions are initially coded thematically using a conceptual framework from the SITES2 study (Kozma, 2003, p13), but an iterative

approach is adopted with the initial framework being modified to incorporate new codes to reflect emerging themes.

This article reports evaluation findings from Cycle 3, which took place in late 2012 and early 2013 and is of particular interest for the development of information literacy. The findings below draw mainly from the 47 case studies conducted for this cycle. The overall focus of this cycle was on engaging students in the process of design. This builds on work from previous cycles which focused on learning beyond the classroom (Lewin et al, 2012) and individual and group learning (Lewin et al, 2013). Four Learning Stories (Redesigning School, Visualizing the Planet Surface, Designing a Physics Simulation, Designing a Maths Learning Game) were presented to teachers in Cycle 3¹, each underpinned by a set of six Learning Activities (Design Brief; either Contextual Inquiry – Observe or Contextual Inquiry – Benchmark; Product Design; Participatory Design Workshop; Final Product Design; and Reflection). As illustrated below, these Learning Activities can be mapped onto concepts commonly found in information literacy models.

Models of information literacy

Precise definitions of information literacy have long been disputed. Heather (1984) could find no general agreement on the boundaries of information skills in her review and this issue has been raised by many authors since (eg Muir & Oppenheim, 2001; Bundy, 2002). The Association of College and Research Libraries (ACRL), Chartered Institute of Information Professionals (CILIP), Society of College, National and University Libraries (SCONUL) and the Research Information Network (RIN) are just some of the many organisations to have devised their own definitions. Perhaps the closest to a universal definition remains the 2005 Alexandria Proclamation, “Information literacy empowers people in all walks of life to seek, evaluate, use and create information effectively to achieve their personal, social, occupational and educational goals” (High Level Colloquium on Information Literacy and Lifelong Learning, 2005).

There are a number of information literacy models which can be used to support the school curriculum. Table 1 compares the core principles of some of the most commonly adopted, namely:

- Big6² - One of the most long-established and well-known models, Big6 is a process model describing how people of all ages solve an information problem;
- CILIP’s skills of an information literate person³ defined as a set of eight competencies;
- PLUS (Purpose, Location, Use, Self-evaluation)⁴ - Specifically designed for schools, PLUS “seeks to provide school students with a positively named tool or scaffold which will help them to improve their own learning by making them more information literate”;

¹ Not all Learning Stories were presented in all countries.

² <http://big6.com/>

³ <http://www.cilip.org.uk/get-involved/advocacy/information-literacy/pages/skills.aspx>

⁴ <http://farrer.csu.edu.au/PLUS/index.html>

- SCONUL's Seven Pillars of Information Literacy⁵ – This is designed for higher education, but its basic concepts are applicable at other educational levels;
- American Association of School Librarians' (AASL) Standards for the 21st Century Learner⁶ – This differs from many other models as it places information literacy within a wider social context, perhaps, reflecting more accurately the role of information in the twenty-first century.
- The ACRL's Information Literacy Competency Standards for Higher Education⁷ – This is designed for higher education, but is closely linked to information literacy in schools as it extended the work of the AASL's Task Force on Information Literacy Standards.

[Insert Table 1 here]

Of course this is far from an exhaustive list; there are many other models, for example, ANCIL (A New Curriculum for Information Literacy) and EXIT: Extending Interactions with Text. However, the models compared in Table 1 are among the most widely recognised and currently used within education.

Although the information literacy models presented here are from the UK or the US, there has been increasing interest in information literacy throughout Europe in recent years, supported by EU-funded projects such as VERITY (Virtual and Electronic Resources for Information Skills Training for Young People) (2000) and EMPATIC (Empowering Autonomous Learning Through Information Competencies) (2012). However, the majority of approaches have tended to come from the English-speaking world, although these are often used more widely, for example, Big6 is available in 18 languages.

As can be seen from Table 1, while the detail of each model varies, they each follow a broadly similar pattern, consisting of a planning stage, followed by information discovery; then evaluation of the information and extraction of relevant details; before presentation or communication and, in most models, evaluation of the process. The models are also similar in that a sequential process is suggested, even if the accompanying guidance refers to an iterative or flexible approach. Furthermore, in most cases, the focus is on the learner as a consumer, evaluator and organiser of information which has previously been produced, rather than as an creator and originator of knowledge.

Previous critiques of information literacy models

Despite the widespread acceptance of models for teaching information literacy skills among librarians, they have been subject to remarkably little critical examination. Where this has occurred, it has tended to focus on models aimed at higher education, for example, Kutner and Armstrong's (2012) reflection on ACRL Information Literacy Competency Standards for Higher Education or Johnston and Webber's (2003) review encompassing

⁵ www.sconul.ac.uk/sites/default/files/documents/coremodel.pdf

⁶ <http://www.ala.org/aasl/guidelinesandstandards/learningstandards/standards>

⁷ <http://www.ala.org/acrl/standards/informationliteracycompetency>

models used in the UK, US and Australia. One of the few articles to consider information literacy models designed for use in schools, Branch and Oberg (2003) compared The Nine Step Plan (Marland), the PLUS model (Herring) and EXIT: Extending Interactions with Text (Lewis and Wray).

As Branch and Oberg (2003) point out, finding and interrogating information sources is usually “a strong section” within information literacy models; this is unsurprising as information specialists are likely to be skilled and confident in this area. However, they argue that information literacy models are much weaker in the ways in which they address the ‘messier’ aspects of the process, “when students have information in hand and are creating their own new knowledge” (Branch and Oberg, 2003). It appears to also be true of models designed for higher education, as Kutner and Armstrong (2012) concur, criticising, “the predominantly skills-based approach” which they feel is, “not sufficient to facilitate teaching of twenty-first century ‘deep information literacy,’” (Kutner and Armstrong, 2012, p.25). Likewise, Johnston and Webber (2003) criticise the “prescriptive guidelines” approach to information literacy which they encountered.

None of the schools-based models Branch and Oberg considered dealt adequately with the creation (or re-creation) process, with the only model mentioning this aspect, the PLUS model, focusing on written forms alone. While the models do acknowledge that sharing of information would take place, Branch and Oberg felt that none explained how this might occur or showed an appreciation of the importance of audience. Furthermore, they found that insufficient attention was paid to revision, rewriting, reworking, revising and revisiting in order “to make the creation the best it can be” (Branch and Oberg, 2003).

It is easy to criticise models for being over-simplified, but Branch and Oberg (2003) further argue that the models they analysed, “tend to overemphasise linearity and often do not accurately reflect the recursive nature of the phases within the process or within the whole process”. Markless and Streatfield (2007) agree that although models may make reference to the need for flexibility or refer to the recursive construction of knowledge, the way in which most are presented invites their sequential and mono-directional application rather than encouraging adaptation.

Furthermore, Branch and Oberg (2003) felt that a weakness was that models they reviewed were designed for use by individuals, rather than groups.

The following section draws on findings from iTEC to consider how effectively information literacy models which are currently available can support emerging technologically-engaged pedagogies.

iTEC in the classroom

To put iTEC in context regarding information literacy, it may be useful to consider some short examples describing the types of activities taking place in classrooms. Two classes, one in Spain and the other in Slovakia, both implemented the same learning story: designing a maths learning game, but using slightly

different processes. In Spain, the first stage was a preparatory phase when the tools which were to be used were set up, for example blogs and Dropbox⁸ accounts, and students were instructed in their use. This was followed by an idea generation stage when students gathered information, searched for relevant games on the Internet, then evaluated each to gauge its advantages and disadvantages. Based on this information, teams of students designed their own games, first on paper and then electronically using SMART Notebook. They presented these to the class for feedback, which they used to revise their designs. Throughout the project, students maintained a blog to reflect on, and evaluate, their experiences. In the Slovakian case study, the project began with students examining and measuring the section of the schoolyard where their games would be situated and speaking to the headteacher about his expectations. They then searched online for information about games which would be suited to the space and evaluated these in relation to a set of criteria devised by their teacher. Each team then agreed on a concept for a game and students designed a 3D model to present the game using the program SketchUp⁹. They introduced these games to a group of younger students and observed their reactions and preferences. After making revisions based on this feedback, the final stage of the project saw the students presenting their final designs to the headteacher and making a case to redevelop the schoolyard.

The majority of projects undertaken as part of iTEC followed a similar pattern to these examples. Although the term information literacy was not used by teachers and librarians were rarely involved in projects, the activities conducted involved a number of activities and skills commonly included in information literacy models, including preparation and planning; information discovery; evaluation (of information); evaluation (of the process and outputs); presentation and communication. However, there were often additional stages included which do not usually feature in information literacy models, such as design, obtaining feedback and redesign. In addition, key activities in the learning process including information gathering from primary sources (as in the initial stages of the Slovakian case study above) and collaborative working are not explicitly supported in most information literacy models although they may form part of one or more of the stages described. Each of these processes will be considered in more detail to determine whether there is a case to be made for incorporating them into information literacy models.

Design in iTEC

One of the most innovative aspects of the third cycle of iTEC is that design is a central feature of each of the Learning Stories. Rather than treating design as a discrete subject, it is viewed as a skill set which can be taught, as opportunities arise, across a range of subjects. Of course, teaching generic skills cross the curriculum is not a new concept; it is an approach which has been used for many years for subjects such as literacy, numeracy and ICT (ACARA, 2013, Department for Education, 2004a, Department for Education, 2004b, National Academy of Sciences, 1996, National Numeracy, 2013). A number of information literacy models

⁸ <https://www.dropbox.com/home>

⁹ <http://www.sketchup.com/>

stress the importance of synthesis skills, for example, “the ability to bring together related ideas, facts and information about a topic and relating this to existing knowledge” (Herring, 1996), and presenting information in a way which is suitable for the intended audience, for instance, “the ability to communicate/share information in a manner or format that is appropriate to the information, the intended audience and situation” (CILIP, 2012). This might include choosing an appropriate communication channel and writing style for example. In classes engaged in iTEC, however, students were not simply asked to present information, but to use the information they had gathered to design a game, or other resource, for a particular audience. This, naturally, required them to make far more complex decisions than whether a presentation, written report or a webpage (CILIP, 2012) would be most appropriate. While an essay or presentation would have a fairly standard structure which would be familiar to students, those participating in iTEC were offered the freedom to devise their own framework, for instance, the format and rules of the game.

In this way, design offered students greater opportunities to be creative:

...the chance to have contact with new concepts and to put their ideas into practice, because they can also be creative here. They can and should have the chance. (Portugal-teacher)

This freedom was motivating for students, but at the same time a source of concern. They were highly conscious that the task had a practical purpose and real life application, and was not simply an exercise which their teacher would grade. They were aware that others would view, and review, their work, so while creating a resource which would be more widely used gave students a sense of purpose, they also felt a strong sense of responsibility to ensure that activities they designed were of high quality.

We have undertaken a project about alloys. We knew that the activity was for our classmates or generally for any other children who would like to try it. We made sure that it will be of interest and fun to do, to attract the children to use the final product. If I were a kid who receives the task, I would enjoy doing it. Meanwhile we don't have users or those who wish to be, but I know that our product can be used by others. It is a quality teaching activity, so we will wait and see. (Israel –student)

Teachers too experienced challenges. As the teachers involved in iTEC come from a wide range of disciplinary backgrounds, very few had experience of teaching design previously and some initially found it difficult to assimilate into lessons:

Design in itself seemed exciting, but the process of design is too far removed from most Norwegian teachers to be meaningful (at least in STEM [Science, Technology, Engineering and Mathematics] subjects). (Norway-National Co-ordinator)

For many teachers, using technology for design purposes was novel. They might be familiar with technologies to support research or presentation, but iTEC compelled teachers to reconsider how, and for what purposes, they used technology.

Before participating to iTEC Project, I thought that technology could be used mainly for the realization of the final product: we work in class in a traditional way, so the students could make their own PowerPoint presentation or whatever. Here is different, because technology is used throughout the project ... to reach the goal. In this way, I've changed my idea of the use of technology. (Italy-teacher)

Teachers and students had to decide which tools were best to support each task in the design process, for example, should blogs or video be used for students to record progress and reflect, or would Dropbox or the social learning platform Edmodo¹⁰ be the best solution for student teams to store and share documents?

Engaging students in design tasks therefore has some important benefits as it can stimulate creativity and prepare them for the types of tasks they are likely to encounter in the workplace, but it is a significant change of approach for both teachers and students and this brings challenges which both groups require support and experience in order to deal with.

Feedback and redesign in iTEC

Although the final outputs of iTEC were focused on design and creation, in most cases, students were also required to present their designs to an audience, but this was markedly different to their previous experiences of presenting work. Most classes took part in a participatory design workshop in which students met with a small number of potential users, or sometimes their classmates, to present their prototype and elicit feedback, which they then analysed in order to refine their design. Crucially, this meant that, in contrast to most information literacy models, presentation was not seen as the culmination of the project, but as a formative activity which was used to review and revise ideas. Students were, therefore, not simply required to produce a polished presentation, they needed the skills to combine presentation with opportunities to obtain and record feedback from their audience. For example, in a case study from Hungary, students devised feedback questionnaires to be completed by the younger students to whom they were presenting their game designs. In order to prepare for this, students had to consider what information would be most valuable to help them to refine their games, and what format and language would be best to obtain this information from the younger students.

The process of presenting unfinished work to a group for feedback was new to most students and some struggled with receiving constructive feedback, and also giving this feedback to others if required. Although students were familiar with the idea of a teacher commenting on their work, presenting their ideas to a wider audience and dealing with potential challenges was an uncomfortable experience for many, as one teacher described:

One of the challenges from the teacher's perspective to teach students to do peer evaluation and to learn to accept others' evaluations and to learn how to use this evaluation to improve their learning. (Spain-National Co-ordinator's report)

¹⁰ <https://www.edmodo.com/>

Information gathering in iTEC

Another way in which iTEC activities do not map onto the format suggested by most information literacy models is that students are responsible for creating not only the finished product, but also much of the information used to inform its design. So, in addition to locating information from the Internet and other pre-existing information sources, students engaged in primary research, observed their environment and recorded the information they discovered using photographs, video and audio. For example, in a case study from the UK, students were set the task of redesigning an aspect of their school to better meet the needs of a particular user group. Students explored the school to examine it from a new perspective. They used iPads and Flip Video camcorders to help them to collect information in video and photographic formats which they were later able to search to select the best options to incorporate into their final design. They also used these mobile devices to record their own reflections, both verbally and in writing, about their observations (Hully, 2013).

‘Location skills’ referred to in information literacy models are normally taken to refer to the ability to search books, webpages, journals, library catalogues, databases and similar secondary information sources. Some examples include using back of book indexes; scanning RSS and newsfeeds; and using hypertext, URLs and bookmarks (CILIP, 2012). For students in iTEC, however, locating the information they needed was a more wide-ranging activity. They needed the ability to identify and extract potentially valuable information from a much more diverse range of sources, including potential users of their designs.

Collaboration in iTEC

Team working was another important feature of iTEC as students worked in teams to co-create, or co-design, resources. For example, in a case study from Austria, teams were created to mix students with strong creative skills with those who were adept at programming. Students adopted different roles depending on their strengths. Working in this way was new to many students and it proved to be a challenge for those more familiar with working individually or relying on their teacher to take responsibility for the organisation and direction of more complex tasks.

Student 1: Not particular difficulties ... I think more issues between us ... there were initial difficulties in organizing ourselves...

Student 2: Yes, because at the beginning ... everyone had a task, then when we started we realized that maybe we had to work together. So we re-focused everyone's task.

Interviewer: Is this mode new?

Student 2: This is not new, it is rather a difficult mode to implement in the classroom. I think sometimes we tend to not use this mode, not so much because of the teacher, but because of the students, who are often not so keen on working in groups. In the classroom there are good and bad relationships between students and so it is sometimes difficult although it brings to new challenges and relationships.

(Italy-students)

This aspect of iTEC is important for information literacy because, while the importance of collaboration has been recognised as a feature of the changing educational landscape, information literacy models remain focussed on individual skills and endeavours for the most part. Models often refer to the ‘information literate individual’ or ‘information literate person’ (ACRL, 2000, SCONUL, 2011), but make little or no reference to appropriate methods of sharing information. For instance, SCONUL’s Seven Pillars model refers to “a personal need for information” (SCONUL, 2011, p.5) and the examples given by CILIP for how to “understand how to manage your findings” (CILIP, 2012) make no reference to sharing and group access to information. It would therefore appear that the growing emphasis placed on teamwork in relation to the use of new technologies and social constructivist approaches to learning has not been fully reflected in the development of information literacy models.

Flexibility in iTEC

Although teachers involved in iTEC were provided with a framework of learning activities to guide them, it was clear from the case studies that classes did not always follow the same process and variation was possible in the content, structure and sequence of activities. Rather than being seen as a problem, teachers valued the flexibility of this approach which allowed them to adapt to the needs and interests of their students, and gave the students themselves opportunities to be creative. In one interview, an ICT Co-ordinator emphasised the ‘power’ of maintaining a degree of ambiguity:

The power of this kind of scenario is that it remains adaptable on a lot of levels. (Belgium- ICT Coordinator)

While the two ‘packages’ of learning activities presented to teachers in Cycle 3 varied in only one aspect, in Cycle 4, greater flexibility is planned. In total, eight learning activities will be presented: dream, explore, map, reflect, show, make, ask and collaborate. These are grouped into three ‘packages’: observe and create, benchmark and create, and benchmark and plan. The guidance for teachers demonstrates how these can be used in different sequences, with some activities being repeated at more than one point in the process. However, as in Cycle 3, it is likely that teachers may further adapt and reorder these packages.

This degree of flexibility, which appears to be highly valued by teachers, is not a strong feature of existing information literacy models which present information handling as a sequential, mono-directional process..

Discussion: the implications for information literacy models

A comparison of the activities encouraged in iTEC with those supported by information literacy models, indicates that there are a number of gaps or discrepancies between existing models and emerging pedagogical practices which combine pedagogy 2.0 techniques with the use of web 2.0 technologies. It is acknowledged that only a selection of information literacy models have been considered, but these include the most commonly used. Furthermore, other models, for example, the Scottish Information Literacy Project (2013) and

the Welsh Information Literacy Project (2011) also follow patterns broadly similar to those in the models outlined in Table 1.

There would be little point in calling for the redesign of information literacy models simply to fit the needs of a fixed term project. However, the pedagogies supported through iTEC suggest some of the ways in which many classrooms are likely to change in the future, with technology being integrated throughout the learning process; constructivist approaches and collaborative learning encouraged; and students taking on a role as producers, and not just consumers, of knowledge. As Farkas argues, “our ideas about what it means to be information literate and what we teach regarding information literacy must change to match the current social, educational, and technological environment.” (Farkas, 2012, p. 89). So how should information literacy change to ensure it is relevant to the classroom of the future?

Design and creation

Design played a central role in Cycle 3 of iTEC, and will continue to do so in future cycles. Engaging in design activities in the classroom was found to be motivating for students; it encouraged creativity and strengthened links between the skills taught in school and the skills students will require in the world beyond school.

Creativity is said to be one of the most important competencies required by twenty-first century employers (Florida, 2002), and when creativity is acknowledged by, and promoted through, policy it is often in response to employability and competitiveness concerns.

It is noteworthy that, while ‘seek’, ‘evaluate’ and ‘use’ are included in information literacy models as a matter of course, the other action included in the Alexandria Proclamation definition of information literacy, ‘create’, is seldom referred to. Just as literacy is not just about reading, but writing too, likewise, information literacy needs to be about production of knowledge, as well as its consumption. There are signs that this is starting to be recognised, for example, the ANCIL (A New Curriculum for Information Literacy) project draws attention to the importance of collaborative tools which can be used to create and share information and the need to evaluate the strengths and weaknesses of online user-generated content as sources of information (Secker, 2011). Although this model is not widely used at present and is clearly aimed at higher education, its broad conclusions are also highly relevant to schools.

The AASL’s Standards for the 21st Century Learner is, perhaps, one of most radical information literacy models currently available. This describes how students need to learn to:

- Use the writing process, media and visual literacy, and technology skills to create products that express new understandings.
- Use strategies to draw conclusions from information and apply knowledge to curricular areas, real-world situations, and further investigations.
- Create products that apply to authentic, real-world contexts.
- Use creative and artistic formats to express personal learning (AASL, 2007).

The findings presented here suggest that these, or similar, guidelines should be incorporated as standard practice in information literacy teaching. Traditionally, information literacy models, like many teaching practices, have been situated within academia, privileging conventional resources, such as books and journals, and academic conventions, such as citations and footnotes (CILIP, 2012), and are, thus, focussed on reproducing and summarising existing knowledge in established formats. In the past, models have not been designed to support the type of tasks which many students will encounter when they enter the workplace, tasks which will require them to design, and to create new knowledge. Future information literacy models therefore need to provide support for knowledge creation, as well as its use. An effective way to achieve this may be to incorporate elements of well-established design process models into information literacy, for example, the design loop (Hutchinson and Karsnitz, 1994) or the Design Council's (2005) 'double diamond'.

Information gathering

Incorporating design and creativity into information literacy has implications not only for the evaluation, synthesis and presentation elements of information literacy models, but for information gathering too. It means that, not only does the importance of user-generated content need to be addressed more directly, but the role of information collected through primary research needs to be considered too. Primary sources, such as observation and interviews, are rarely mentioned, even in more innovative information literacy models such as ANCIL and AASL, despite evidence that people and the environment are important sources of information for young people (McNicol et al, 2001). Information literacy frameworks need to include guidance on how to collect, record, analyse and evaluate a much broader range of sources, including advice on how to select those sources which are most appropriate for the task, whether these are traditional academic outputs, or more informal, sources.

Collaboration

Rather than treating information literacy as an individual endeavour, in the future, information literacy, "will have to address knowledge creation through dialogue and negotiation of meaning" (Farkas, 2011, p.90). The AASL (2007) model is unusual as it stresses the importance of students learning to, "Collaborate with others to exchange ideas, develop new understandings, make decisions, and solve problems". The ACRL model also points to the importance of group working, although only at the communication and presentation stage. In iTEC, students collaborated throughout the entire task. To adequately support this type of pedagogy, information literacy models need to include guidance on collaborative planning, information discovery, evaluation, synthesis, presentation, information management and, of course, design and redesign. This includes the use of web 2.0 tools, but also topics such as peer support and review, working in learning communities and managing team working.

Flexibility

While existing models may claim to be non-linear, their presentation and explanatory text suggests that a linear approach is still seen as the ideal. For example, in the recently published *Information Literacy*

Framework for Wales, although it is acknowledged that skills development is “not always” linear, there remains a strong emphasis on order and progression:

We recognize however that learning and skills development do not always happen in neat consecutive progression. They may follow an iterative or cyclical rather than linear progression. (Welsh Information Literacy Project, 2011, p6)

It seems that ten years on from Branch and Oberg’s (2003) review, “the messy stuff” which typically involves moving between elements such as planning, reflection, creation, review, information gathering and evaluation in a much more unsystematic fashion, is still being missed from information literacy models.

In the past, the flexibility of information literacy models was limited by the difficulty of presenting a model in a completely non-linear way in print. A model designed to be viewed online, however, has greater possibilities for flexibility through methods such as hyperlinks and user-customisation. Technology makes it possible to create a model consisting of a number of activities or skills which can be blended together in different ways, to meet the needs of individual learners, including repeating the same activity at various points in the process.

Future steps

In summary, an information literacy model for twenty-first century needs to be flexible, suited to collaborative work and most importantly acknowledge and support students as creators of knowledge, not simply consumers. The next stage in this work will be to create such a model, based on the iTEC learning activities and taking account of the considerations described in this article. This will then be tested among librarians and teachers within iTEC and more widely.

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